COOPERATION

COOPERATION
AGREEMENT
FOR FORESTRY
DEVELOPMENT

HARDWOOD THINNING MANUAL

Canada

Nova Scotia

Front Cover: Sugar maple stand 10 years after thinning.
Gully Lake, Colchester County, Nova Scotia.

Photo Credit: Robert W. Young

Hardwood Thinning Manual

Ronald G. Robertson and Robert W. Young
Nova Scotia Department of Natural Resources

and

John C. Lees
Forestry Canada - Maritimes Region

Printed under the Canada / Nova Scotia
Cooperation Agreement for Forestry Development

Forestry Canada Forêts Canada

Department of Natural Resources

93-00897/

ACKNOWLEDGEMENTS

The authors wish to thank the following for reviewing the script and for their helpful comments: Harold Alexander, Bob Bancroft, Malcolm Barkhouse, Steve Brown, Harold Carroll, Dan Eidt, Ross Hall, Gerry Joudrey, Gerry Linfield, Tom MacMillan, Russell McNally, Earle Miller, Kevin Pentz, Wade Prest, Tom Skinner, David Sutherland, Jacob Verboom and Tim Whynot. Also Jennifer MacDonald for typing and re-typing many drafts.

Graphics: Gerald Gloade

Produced by: Land Registration and Information Service
(L.R.I.S.), Amherst, Nova Scotia, 1991.

CONTENTS

Acknowledgements 2
Introduction 4
History 5
What is Thinning 6
Advantages of Thinning 6
Stages in Natural Stand Development 7
The Thinning Process 9
Silvics of Suitable Species 13
White Ash 13
Red Maple 14
Sugar Maple 15
Red Oak 16
White Birch 17
Yellow Birch 18
Beech 19
Getting Ready 20
Timing the Operation 20
Planning the Work 21
Extraction Trails 22
Marking 24
Training the Workforce 27
Thinning a Sugar Bush 31
Supervision and Quality Control 33
Wildlife Considerations 35
Environmental Considerations 36
Conclusion 37
Glossary 38
References 41
Further Reading 42
Natural Resources Offices 43
Forestry Canada Offices 45
Notes 46

INTRODUCTION

Hardwoods are an extremely important component of our Nova Scotia forests, comprising one third of the **growing stock**.[1] They are used for a wide variety of products.

As a rule, the overall quality of our hardwood trees is not good compared with those of Central Canada or New England. This can be attributed to damage by insects, animals, diseases and other factors such as climate, site and historical **high-grading**. Nevertheless, there are many **stands** growing on good sites with potential **crop trees** - and these are the areas we need to identify for appropriate treatment.

The purpose of this booklet is to help you decide if a stand is suitable for treatment, and likely to respond according to the thinning guidelines prepared by the Department of Natural Resources. It may be read in conjunction with the Hardwood Guide in the **Forestry Field Handbook** also prepared by the Department.

Owners can expect large trees at final harvest by selecting healthy, well formed crop trees of the right species now, and freeing them from competition. In addition, they can often use or sell the trees they cut now for fuel or pulpwood.

Marking trees, and cutting and extracting **thinnings**, requires skill and understanding. It is hoped that this manual will help foresters and forest technicians select and mark appropriate stands, and train silviculture crews. It should also enable woodland owners, silviculture contractors and forest workers to carry out the work in a professional manner.

[1] Terms in **bold type** are defined in the Glossary.

HISTORY

In Europe, valuable hardwood species have been thinned over the centuries to produce more valuable products (sawlogs and veneer). In France, as early as 1560, Tristan de Rostaing developed the practice of "éclaircie par le haut". This **crown thinning** was adopted in mixed stands of oak and beech to promote the growth of the finest trees for use in shipbuilding, house building and furniture making.

Until recently intensive management was not considered necessary in Canada. As in other parts of the world, it took predicted wood shortages to get silvicultural practices underway.

In Ontario and Quebec, stands of quality hardwoods have been thinned to improve the final product. In Nova Scotia at Sugarloaf Mountain, Cumberland County, Forestry Canada thinned a 35 year old mixed stand of yellow birch, sugar maple and beech in 1959 and did a further thinning in 1978. The thinnings favoured maple and birch and discriminated against beech. In the 1960s the Department of Lands and Forests thinned red oak stands in the Kedge Management Area, Queens County and, in the 1970s and 1980s mixed hardwoods in the Anna-King Management Unit in Annapolis and Kings Counties.

In 1978, the Department of Lands and Forests Research Division established a series of permanent sample plots in hardwood stands that had been thinned to different **intensities**. From these plot measurements, hardwood **thinning guides** were prepared and published in the 1988 revision of the Department's **Forestry Field Handbook**.

WHAT IS THINNING?

Thinning is defined as cutting undesirable trees in an immature stand to increase diameter growth and improve the average form of the trees that remain. Its purpose is to give the remaining trees more growing space, above and below ground, allowing them to grow faster, and to salvage trees which would die from competition. Thinning improves stand quality by removing poorly formed, defective trees and by concentrating future growth on selected trees.

ADVANTAGES OF THINNING

Thinning:

- Improves the proportion of preferred species (e.g., yellow birch, and especially sugar maple in sugarbush).

- Improves the quality of the average crop trees being grown to final harvest (e.g., yellow birch veneer, white ash logs).

- Harvests wood that would otherwise be lost through natural mortality.

- Increases rate of diameter growth and grows trees to log and veneer size sooner.

- Reduces final harvesting costs by growing more merchantable volume on fewer trees and eliminates most of the unmerchantable understory.

- Prepares stand for future **shelterwood harvesting** especially with species such as sugar maple, white ash and yellow birch.

- Improves stand appearance for aesthetics and recreation.

- Improves access for recreation (e.g. , walking, cross-country skiing).

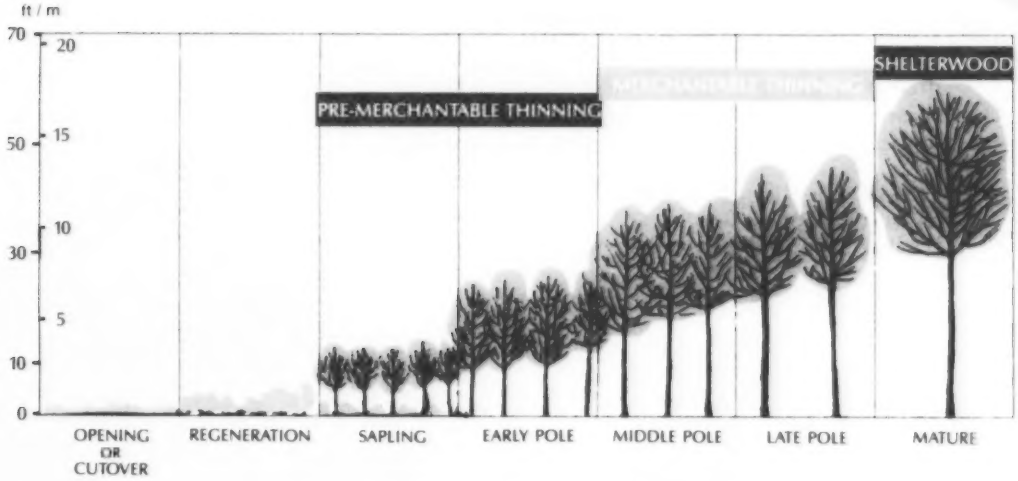
- Improves wildlife habitat.

- Improves health of stand by cutting trees infected by insects or fungus.

By following the hardwood thinning guide in the Forestry Field Handbook, foresters and forest technicians can predict the average diameter and volume of the stand when it returns to full stocking, for example, after 20 years.

STAGES IN NATURAL STAND DEVELOPMENT

Let us consider the development of an average **even-aged** hardwood stand from seedling or **coppice** growth to maturity, and how the natural thinning process takes place.



Stages in Natural Stand Development

In Nova Scotia hardwood trees develop from seed, root suckers or stump sprouts. Thousands of tiny seedlings, suckers or sprouts grow into small trees and then **saplings**. A stand may be described as one of seedling, sucker or sprout origin or a combination of these. In Europe, trees of seedling origin are usually encouraged to grow into valuable timber trees and the coppice derived from stump sprouts or root suckers is often cut on short rotations providing firewood and small dimensional products. In the ancient system of "**coppice with standards**", the coppice is cut on short **rotations** and the **standards** are grown to become large timber trees. Standards should, if possible, be of seedling origin since coppice shoots growing for a long time tend to become unsound at the butt.

The sapling stage is a time of fierce competition. However, this overcrowding is desirable for sawlog production, especially with hardwood species which tend to become branchy, if open grown.

In dense stands, trees develop clean stems, free from lower living side branches, and crowns become confined to the upper part of the tree. This **natural pruning** makes trees resemble poles and the pole-stage is a recognizable one in stand development. In hardwoods, at the time of thinning, crop trees should have at least 5 m (16 feet) of clear **bole** and preferably more.

White ash self-prunes well in dense stands.

As a stand develops, white ash generally requires more open conditions.

THE THINNING PROCESS

Mixed hardwood stands left untended are often crowded with low quality species and poorly shaped trees. Although these grow to maturity, the process can be slow and the resultant stands are often of poor quality with few saleable products.

It need not be like this, however. If your objective is to grow single, straight, high quality trees, skillful thinnings will help you do it.

Look Up and Decide Carefully

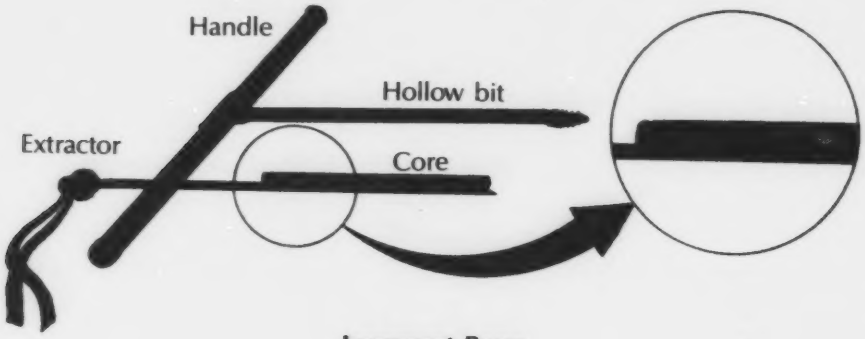
Usually hardwoods do not require thinning until they reach 8 - 13 cm (3 - 5 in.) in diameter and are about 25 years old. In fact, as stated earlier, close spacing of young trees is desirable because it prevents excessive branching, forking and trees grow straighter. As the stand grows, there comes a time when crowding will hamper crown and root development. From a purely silvicultural viewpoint this is the time a thinning should be done. A disadvantage with early thinning is that many of the cut trees are unmerchantable. Therefore it is recommended that the average diameter of the stand be at least 14 cm (5.5 in.) before thinning.

By following the commercial thinning guide for hardwoods in the Forestry Field Handbook, you can determine the recommended **basal area** removal for any stand and site, predict the number of years it will take for a thinned stand to return to its original stocking level and predict the average diameter of the stand at that time. This is important for the woodlot owner or forest manager whose objective is to grow wood that must meet certain dimensions and log grades.

To start, future crop trees should be selected and marked. The best time is when the leaves are off the trees, so try to do it in late fall or winter when the condition of the upper stem or crown is more easily seen.

Look for straight, disease-free trees without low forks or large branches, scars or dead tops. Cut around these trees to free them from competition. A good rule of thumb is to create 1.5 m (5 ft.) of new growing space around each crop tree crown. Try for an even spacing and don't make big gaps which can cause heavy branching. **Intermediate** or **suppressed** trees can be left as "fillers" to clean up the boles of crop trees and prevent **epicormic** branching.

An increment borer is useful at this stage and can tell much about a standing tree's age, rate of growth and health. It consists of a hollow bit, extractor and handle and is used to bore and extract a slender cylinder of wood. The tree's age is determined by counting the rings from centre (pith) to bark and the width of the annual rings reveals growth rates. Slow growth may indicate competition from other trees and suggest that thinning is due.



Increment Borer

In coppice growth, double, triple and multiple stems of birch, maple, ash and oak growing from old stumps strongly compete with each other. These should be thinned to one or two per stump. Make sure to cut out the forked and crooked stems, taking care not to damage the bark of the stems being left. Stump sprouts can be thinned back to one stem (sawlogs) or two (fuelwood or pulpwood) per stump.

Sprout Clumps Can Be Singled

SILVICS OF SUITABLE SPECIES

To ensure good thinning results, it is important that forest managers, supervisors, and skilled workers understand the silvicultural characteristics of the different species.

WHITE ASH

Moderately long-lived. Perhaps the most useful, and thus valuable, Nova Scotia hardwood. Depending on site quality, it can provide pulpwood, sawlogs, furniture wood, and many specialty items such as basket-splints, tool handles, and sports equipment.

Average Harvesting Age — 70 years, fast growth.

Stump Sprouting — Moderate to high sprouting vigour.

Tolerance — Tolerant at first then only intermediate.

Windfirmness — Windfirm except on wet sites.

Response to Thinning — Response to thinning is good after age 25 and continues to maturity. Cut stumps may produce sprouts which persist and require subsequent thinning. Epicormic shoots do not usually persist at closer spacings.

Appropriate Silvicultural Systems — Shelterwood, Coppice, **Selection**.

Additional Notes — White ash has been overcut in the past and should now be encouraged on fertile sites.
— It should be favoured in mixedwood thinning.
— Sprouts are favourite deer browse.
— Fall colours are purplish.
— Is usually first hardwood to lose leaves in fall, last to **flush** in spring.

RED MAPLE

Moderately-long lived. The most common hardwood in Nova Scotia. Red shoots and leaves in spring and bright red leaves in fall enhance its amenity value. Commonly a fuelwood species.

Average Harvesting Age — 60 years - medium to fast growth.

Stump Sprouting — Vigorous sprouting, abundant seedfall, some root suckering.

Tolerance — Intermediate. Not very tolerant of overtopping.

Windfirmness — Windfirm except on wet soils.

Response to Thinning — Responsive only while young (up to 40 years). Epicormic branches may persist.

Appropriate Silvicultural Systems — Shelterwood, Coppice.

Additional Notes — Stump sprouts can produce logs if thinned to one or two per clump.
— On good soils, there is no risk of decay spreading from cut stump to sprout stems.
— Sprouts are favourite deer browse.

It is important to be able to identify tree species at all stages of growth, in summer and winter.

SUGAR MAPLE

Long-lived. This is a valuable hardwood for many uses: amenity, sap production, furniture wood, sawlogs, pulp and fuelwood (thinnings).

Average Harvesting Age — 80 years, medium growth rate.

Stump Sprouting — Vigorous.

Tolerance — Very tolerant of shade.

Response to Thinning — Good, starting at age 20. Also responds to release in later thinnings to age 60. Epicormic branches may persist at wider spacings.

Appropriate Silvicultural Systems — Shelterwood, Coppice, Selection.

Additional Notes — A favourite tree of woodlot owners and recreational park managers.
— Maple sap production is a legendary and valuable species asset.

RED OAK

Long-lived. Red oak is currently quite scarce and its rich red wood is still in demand for furniture and cabinetry. Its persistent leaves are noticeable in early winter.

Average Harvesting Age — 50 - 100 years. Slow to medium growth.

Stump Sprouting — Vigorous.

Tolerance — Intolerant to intermediate.

Windfirmness — Windfirm, tap-rooted.

Response to Thinning — Good. Thin early, and often. Vigorous stump sprouts can be thinned and managed for logs.

Appropriate Silvicultural Systems — Shelterwood, **Seedtree**, Coppice.

Additional Notes — This is a valuable tree that responds to proper management.
— It is attractive to many seed eating animals and is a worth-while component of recreational areas.
— Susceptible to epicormic branching.

WHITE BIRCH

Short-lived. This **pioneer species** colonizes bare or disturbed soils with its abundant and widespread seedfall. In forest stands, it produces straight clean stems suitable for spoolwood, sawlogs and veneer. Common fuelwood species.

Average Harvesting Age — 60 years - fast growth.

Stump Sprouting — Moderate to low sprouting vigour.

Tolerance — Intolerant.

Windfirmness — Windfirm.

Response to Thinning — Responsive only when young - up to 35 years. Epicormic branches do not persist.

Appropriate Silvicultural Systems — **Clearcutting**, Seedtree.

Additional Notes — An attractive tree that enriches the soil with its vigorous rooting and rich leaf litter.
— Excellent in mixtures.

YELLOW BIRCH

Long-lived. Yellow birch is a valuable sawlog, furniture and veneer species which has suffered from overcutting.

Average Harvesting Age — 80 years - slow to medium growth rate.

Stump Sprouting — Low vigour or none.

Tolerance — Intermediate to tolerant.

Windfirmness — Windfirm, deeply rooted.

Response to Thinning — Response to thinning is good starting at age 20 and continuing to age 55. Epicormic branching persists at wider spacings.

Appropriate Silvicultural Systems — Selection, Uniform Shelterwood, Patch Cuts.

Additional Notes — This is a valuable tree that responds to thinning and later crop tree release.
— Many birds and insects are attracted to its sap.
— Tends to develop into **wolf trees** quickly if spaced too widely.
— Aggressive colonizer on mineral soil.

BEECH

Long-lived. Beech is a significant component of our hardwood forests. It persists despite high cull ratios. Clean beech is still in demand.

Average Harvesting Age — 80 years - slow to medium growth rate.

Stump Sprouting — Weak sprouts, abundant root suckers.

Tolerance — Very tolerant to shade.

Windfirmness — Windfirm. Diseased branches fall off.

Response to Thinning — Good. Discriminate against infested and diseased stems. Favour clean stems that may resist infection till the next thinning.

Appropriate Silvicultural Systems — Shelterwood, Selection.

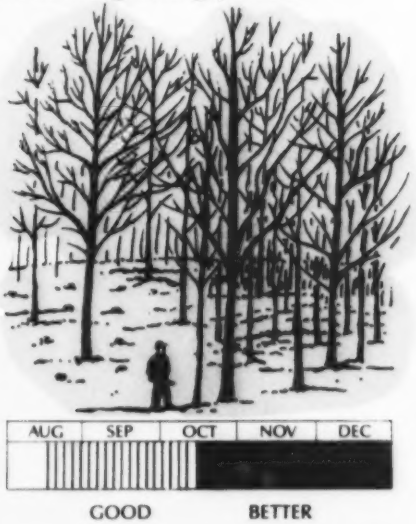
Additional Notes — Research continues for a key to resistance to beech bark disease.

GETTING READY

TIMING THE OPERATION

For best results, schedule hardwood thinnings for late fall / early winter when leaves are off and the ground is frozen. Fall is also an excellent time to sell the wood extracted from thinnings. Many homeowners want to purchase fuelwood and process it for the following year.

Mid-summer / early fall is also a good time to thin. Overall stand health is easily seen by the amount and condition of the mature foliage. Soils are usually drier and are less likely to become rutted during extraction. However care must be taken as crowns are easily damaged during this active growing period.



Time the Operation Appropriately

Winter operations are more difficult. Snow is usually deep and the wood slippery and frozen, making handling treacherous.

Avoid thinning hardwoods during the sap flow period (spring) as bark and root damage can be extensive.

PLANNING THE WORK

An important part of thinning is organizing the work well. Hardwood is heavy, so working smarter, not harder, is a necessity. Know the products to be cut and the equipment to be used to extract them.

Start by taking another walk through the stand to become better acquainted with the site conditions.

Decide on the best locations for trails and landings and mark them on the sketch map.

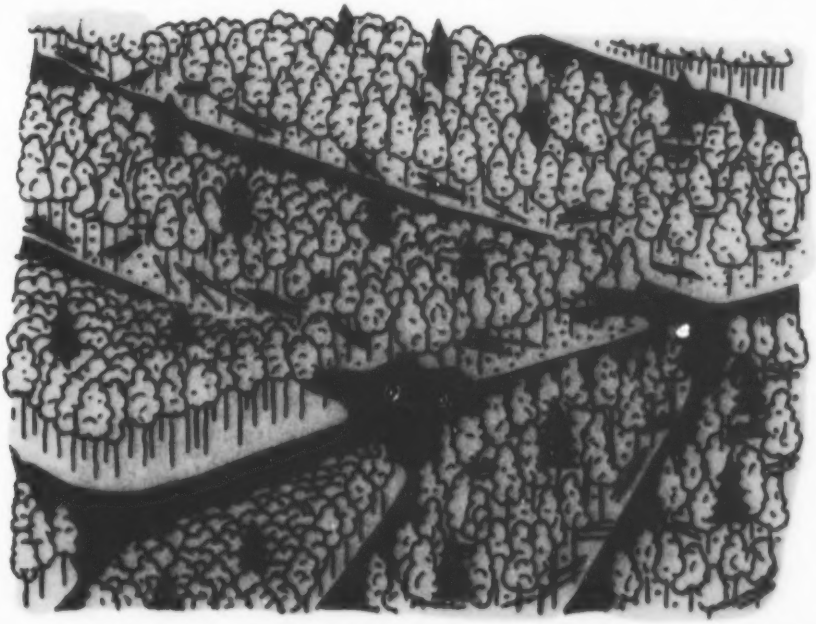
Make use of flat terrain on ridges and avoid steep slopes, soft ground and water courses.

Planning Trails and Landings

Extraction Trails

Flag the location of the main haul road and lay out a series of parallel **extraction trails** in **herringbone fashion**. Mark trail width by spraying a dot of paint at breast height on trees along both sides. Width will depend upon the type of extraction machinery used; it commonly varies between 2.5 and 3.5 m (8 - 12 ft.). Some adjustments may be necessary to go around a good crop tree.

With the **shortwood system**, locate your trails approximately 12 m (40 ft.) apart. Wood will then have to be moved a maximum of 6 m (20 ft.) for forwarding. **Tree-length** and **full-tree systems** often use skidders to move stems in one piece to a landing. Trails can then be spaced approximately 20 m (66 ft.) apart.



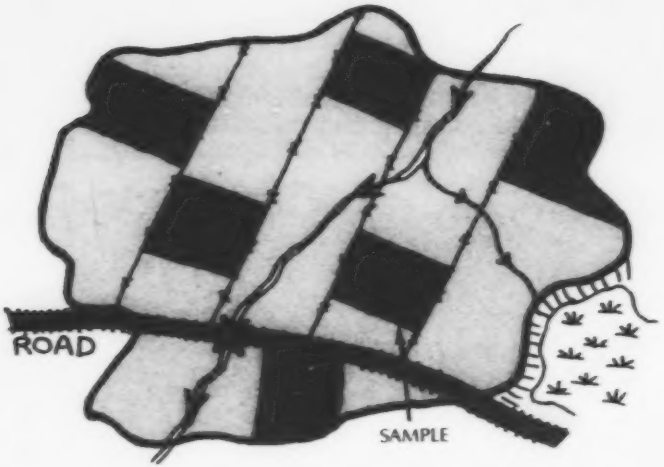
Skidding Using Tree-length System

Try to make trails long and straight, and approach slopes straight on. To reduce damage to standing trees during extraction, widen trails slightly around curves and on hummocky terrain. Leave **bumper trees** along trail edges to protect crop trees during extraction. Make connectors at the rear and mid-way if extracting distances exceed 100 m (330 ft.).

Where trees are widely spaced after thinning and narrow extraction equipment is being used, organized trails are not necessary.

Marking

The importance of marking before cutting cannot be overemphasized. For trained silviculture crews, sample portions should be marked in each worker's strip. This will enable them to become familiar with correct selection and spacing as they continue to thin the remainder of the stand.



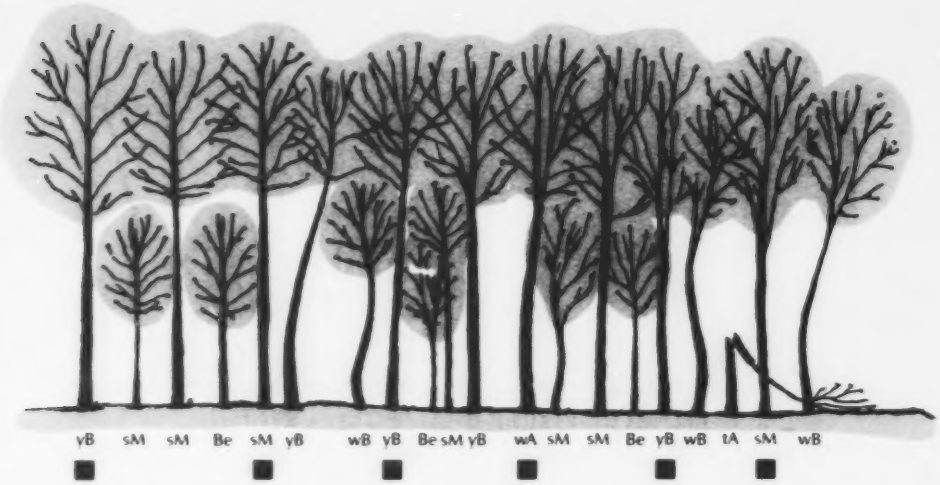
Mark Sample Areas in Work Strips

If the crew is less experienced and uncertain about which trees are crop trees, a complete stand marking is required. This is time consuming but will produce the best results. Depending on the skill of the marker and the species composition and density of the stand, one to four hectares (2.5 - 10 acres) per day is reasonable progress.

There are two methods of marking: trees to keep or trees to cut. Choose the method that requires less marking. In either case, try to keep the most promising trees of the most valuable species. They should be straight and tall with relatively small branches, and should show signs of self-pruning. Crowns should be healthy and capable of growing faster during the next 20 years.

Method 1. Trees to Keep

Mark all trees which are to stay. Ensure they can be easily distinguished by marking them on all sides. This is the method most commonly preferred.

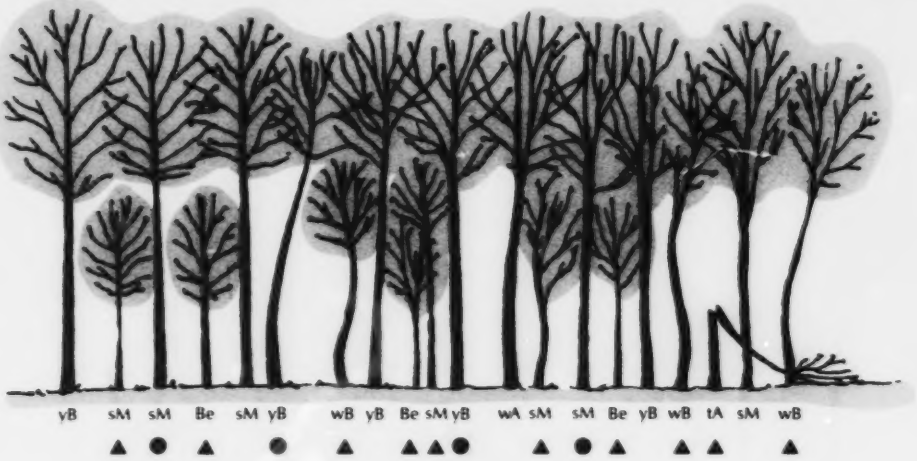


■ Trees marked to stay

Species Symbols: yB - Yellow Birch
SM - Sugar Maple
Be - Beech
wB - White Birch
wA - White Ash
tA - Trembling Aspen

Method 2. Trees to Cut

Mark for cutting only trees that are too close or interfering with better ones. Marking forked, crooked, dead, dying, diseased or unwanted species is usually unnecessary when workers are instructed to cut these as a matter of course.



● Trees marked for cutting.
▲ Trees to be cut (for which marking is unnecessary).

The main consideration with either method is to give additional growing space to potential crop trees needed for lumber and veneer.

Foresters and forest technicians use a prism to ensure recommended basal area is being removed. If you are interested in learning this technique, contact your nearest Natural Resources office (see list pages 43-44).

Mark hardwoods when leaves are off and crowns are clearly visible.

Use a different colour of flagging tape than that used to mark extraction trails.

The goal is to train crews so well that marking is not required.

TRAINING THE WORKFORCE

Training is the key to successful thinning. Felling broad-crowned hardwoods may look difficult but a trained forest worker will use directional felling skills to avoid hang-ups and minimize wood handling.

Start by taking the entire crew (including the extraction machine operator) into the stand. Remind them that by removing competing trees, thinning will enable the stand to produce larger, higher quality trees.

Explain Marking and Work Layout

Next, go over how the job has been organized and what is to be done. Give each person a copy of the working sketch and include written instructions.

Pinpoint the locations of roads, trails, landings and any features that will protect or enhance wildlife habitat. State the distances between trails and clearly indicate where each person will be working. Remind them that safety regulations require that workers be at least two tree-lengths apart to avoid danger from falling trees yet still be within calling distance if they need help.

Then go into the work areas between trails:

- Describe how marking has been done to favour good crop trees.
- Explain how clumps are being thinned back to one or two stems / stump.
- Indicate how approximately 1.5 m (5 ft.) of new growing space is to be left between crowns.

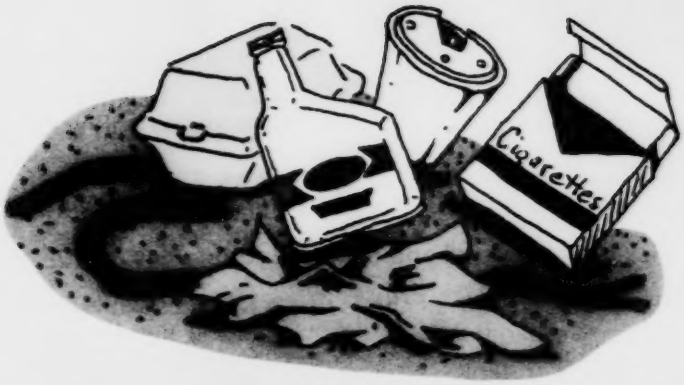
Space Crowns as Evenly as Possible

- Go over the basics of the silvics (e.g. how to distinguish between red and sugar maple) and how each species responds to thinning.
- Explain that care must be taken to avoid damaging the tops, bark and roots of selected crop trees.

Indicate what extraction equipment is to be used:

- Point out how centre lines and trail widths have been marked.
- Explain the importance of cutting trails as straight as possible and wider on curves or hummocks to avoid hauling damage.
- Point out the importance of keeping all stumps low, especially on trails where machinery will be working.
- Indicate where wood and slash are to be piled.
- Make workers aware of the loader's reach capabilities (for shortwood operations). To minimize wood handling and assist with scaling, have workers pile trail trees parallel and those from the treated strips perpendicular along the edges of the extraction routes.
- Show where connecting trails are to be cut.
- Give workers an estimate of the volume of wood to be removed and what products are to be cut; e.g., fuelwood, hardwood pulpwood.
- Explain the method of payment and what production is expected.
- Tell workers to keep the site clean of unsightly debris; e.g., empty oil containers, broken equipment.

Training need not be long but must relate to the stand being treated and to the forest workers' needs.



Gather Up Unsightly Material

- Clarify any confusion by encouraging questions from workers before work begins.

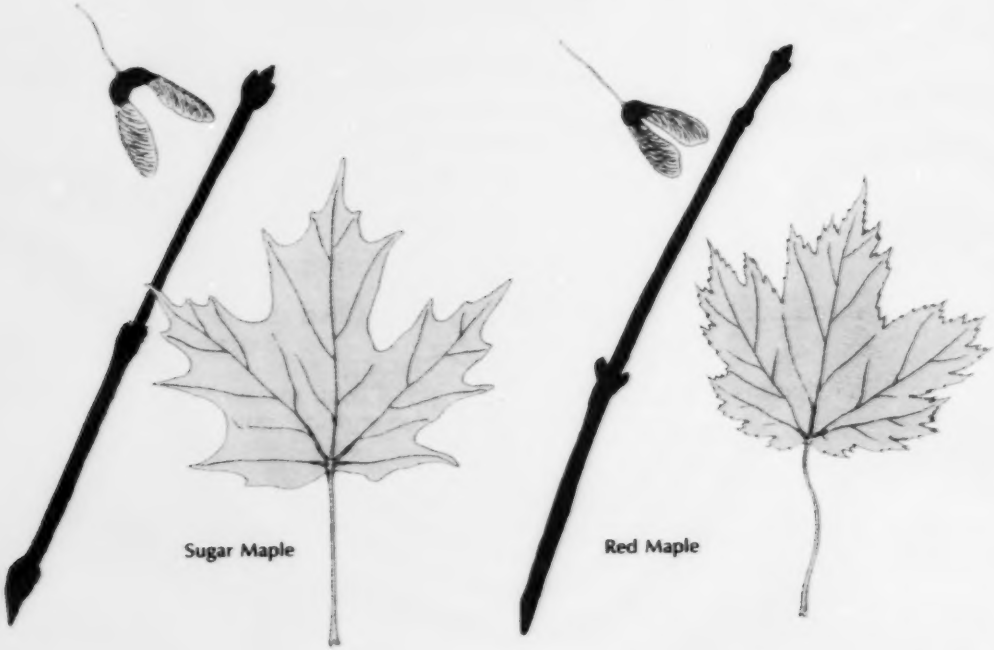
When everyone is satisfied that they know what is required, begin cutting out the trails. When that is completed, work between the trails. To avoid continually walking through slash, start at the rear of the stand and work toward the front.

Workers should avoid attempting to move large trees. Leave them in sufficient length(s) to be bucked by the machine operator either in the thinning or at the landing.

Brush on trails improves machine flotation and reduces rutting.

THINNING A SUGAR BUSH

Although all maple species produce sap from which syrup can be made, the sugar maple yields the most syrup per litre (gallon), so during thinning, aim to leave as many good sugar maples as possible.



Identification of Maples

For best sap production, a tree should have a short bole topped with a large crown and abundant foliage. Thinning a maple grove should be done in such a way as to obtain the greatest possible number of such trees.

Before cutting begins, crop trees should be chosen and marked. Crop trees are maple trees that are currently good sap producers or show good prospects of becoming so. Release these crop trees from competition by cutting surrounding trees and creating increased growing space for the development of deep broad crowns.

Abundant Foliage For Best Sap Production

As in conventional thinning, remove diseased, defective and suppressed trees but leave younger stems to perpetuate the sugar bush. Thin lightly and often. Do not try to make a sugar bush with one thinning. Your crop trees may go into shock if spaced too widely.

For further information on sugar bush thinning contact:

Maple Specialist
Nova Scotia Department of Agriculture and Marketing
Experimental Farm
Nappan, Nova Scotia
B0L 1C0

or your nearest Department of Natural Resources office.

SUPERVISION AND QUALITY CONTROL

SUPERVISION

Now that work has been planned and organized and the workforce trained, the success of thinning depends largely on good supervision. The supervisor is responsible for what the forest workers do with their time, and for controlling the quality and quantity of the work.

QUALITY CONTROL

The supervisor's role is the last step in the management process called control - making sure that all is happening as it should.

Some of the common problems to watch for:

- Are the products being produced to the proper specifications (e.g., length, diameter)?

- Is the trail system used being cut properly (i.e. wide enough, bumper trees left, stumps cut low)?

Shortwood Ready For Extraction

- Can the wood be removed without problems?
- Is the stand being cut according to plan? (Using a prism to determine amount removed is a good way to check before and after).
- Are crowns being properly released?
- Have the poor quality trees been removed?
- How much damage has been done to trees along the trail?
- Are "fillers" being left in gaps to prevent heavy branches developing on crop trees?
- Is "good housekeeping" being practised on-site?

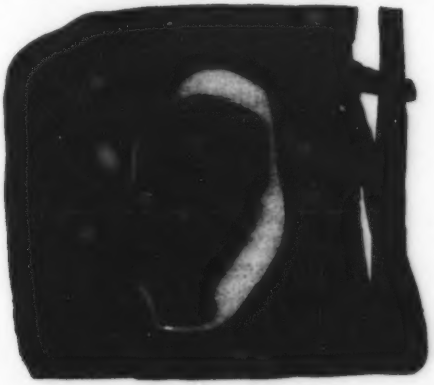
WILDLIFE CONSIDERATIONS

Thinning hardwoods can benefit many wildlife species by creating a new food source from suckers and / or sprouts*. These will be within reach of such animals as rabbits and deer for winter feeding. In this way, thinning creates new browse formerly out of reach. Increased light will also stimulate **herbaceous** growth on the forest floor.

To maximize hardwood regeneration and available browse, the thinning should take place in late fall and through the winter. At this time, nutrients are stored in root systems, so that more nutritious shoots will be available the following winter. All the hardwoods discussed in the manual offer some food in the form of seeds, bark, leaves or twigs.

Red oak, hazelnut and any healthy beech should be left on the site since they are important nut-producers. Non-competing, low growing plants and shrubs should not be cut during thinning. They provide visual protection and shelter from predators.

Hardwood thinning results in a faster growing, well spaced stand that will have larger trees. Large hardwood trees are important for nesting by large raptors and many birds and mammals will use cavities. Wildlife will benefit, and some unharvested trees can be left as snags and cavity trees.



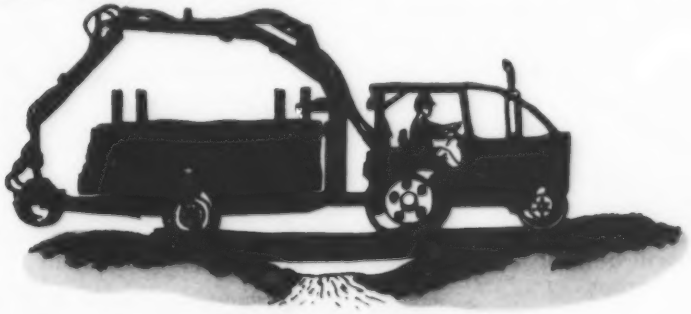
Cavity Tree

* Suckers and sprouts are often undesirable in a maple sugarbush as they interfere with lines.

ENVIRONMENTAL CONSIDERATIONS

Thinning, like other forestry operations, should be carried out in a fashion which minimizes impact on the forest environment. Special steps can be taken to control ground disturbance on extraction trails. These will help prevent possible soil erosion which could lead to siltation damage of water courses. Some guidelines include:

- Shutting down heavy equipment in wet weather to reduce rutting.
- Minimizing ground pressure by adapting extraction machinery (e.g. high flotation tires if trail width permits).
- Installing portable bridges on stream crossings. A permit may be required. For further information contact the Nova Scotia Department of the Environment.



Portable Stream Crossing

- Placing brush mats over sensitive soils like boggy depressional areas. Slash breaks up with each pass of the machine, packs into the soil and retards erosion.
- Repairing any wheel ruts and re-establishing some protective cover over bare soil as quickly as possible. Spreading loose hay is an effective and inexpensive way to protect against run off. Seeds soon germinate and the grasses help to maintain good wildlife habitat.

Care must be taken to avoid dropping any woody debris into streams or lakes and to respect machine exclusion zones along watercourses. In addition, landings should be left in a neat and orderly fashion with all wood and brush removed. Litter including empty oil containers, and broken equipment should be collected and disposed of at an approved site.

CONCLUSION

We hope that this collection of information and instruction about hardwoods is helpful to you. There is really nothing new in it. Hardwood stands suitable for thinning are identified, and can be improved by the silvicultural treatments we have recommended.

Woodlot owners, more than ever, realize the value of hardwoods.

Thinning is one way to improve the health and quality of stands so that a wider range of products can be assured for the future.

Ron Robertson
Bob Young
Jock Lees

GLOSSARY

Basal Area - The cross-sectional area of an individual or of all trees per unit area measured at breast height and expressed in m^2 / ha or ft^2 / ac.

Bole - The trunk or stem of a tree.

Bumper Tree - Trees left along trail edges to protect crop trees often damaged during extraction.

Clearcutting - Removing all trees from an area at one time.

Coppice - A shoot arising from an adventitious or dormant bud near the base of a woody plant that has been cut back.

Coppice With Standards - A method of stand reproduction in which coppice and standards are grown on the same area with the former cut on short rotations and the latter (usually of seedling origin) carried through to much longer rotations (e.g. 15 and 60 years respectively).

Crop Tree - A tree forming or selected to form a component of the final crop.

Crown - The branches and foliage of a tree.

Crown Thinning - A selective thinning which removes trees primarily from the upper canopy (i.e. dominant and co-dominant trees).

Epicormic - A shoot arising spontaneously from an adventitious or dormant bud on the stem or branch of a woody plant.

Even-aged - An age structure where all trees in a stand are of the same or nearly the same age.

Extraction Trail - A trail used to remove wood from a stand to a landing or road.

Flush - A fresh growth of foliage.

Full-Tree System - Felling and transporting the whole tree for later limbing and bucking at a landing or mill.

Growing Stock - All the trees growing in a forest area expressed in terms of number or volume.

Herbaceous - Seed producing plants that do not develop persistent woody tissue above ground.

Herringbone Fashion - A pattern of parallel extraction trails resembling the spinal structure of a herring.

High-grading - The practice of removing only the biggest and best stems resulting in the decline of stand quality over successive rotations.

Intensity - A measure of the combined effect of thinning weight (degree) and frequency in terms of volume removed during any succession of thinnings.

Intermediates - Trees with crowns extending into the canopy formed by co-dominant and dominant trees, receiving a little direct sunlight from above but none from the sides, usually with small crowns considerably crowded on the sides.

Natural Pruning - Freeing the stem of a standing tree from its branches through natural causes.

Pioneer Species - A plant capable of invading bare sites and persisting there until supplanted by succession species.

Prism - An optical instrument used in forest inventory work.

Rotation - The number of years required to establish and grow timber crops to a specified condition of maturity for regeneration cutting - from harvest cut to harvest cut.

Sapling - A young tree, no longer a seedling, but not yet a pole.

Seedtree Harvesting - The removal of mature timber in one cut, except for a small number of seed-producing trees left singly or in small groups.

Selection Harvesting - The periodic removal of mature trees and less vigorous immature trees, individually or in small groups from an unevenaged forest to establish a new crop.

Shelterwood Harvesting - A series of regeneration cuttings in a mature stand designed to establish a new crop under the protection of the old.

Shortwood System - Felling, limbing and bucking on the spot, before wood is transported to a landing mill.

Silviculture - The science and art of growing and tending forest crops, based on a knowledge of silvics.

Stand - A group of trees sufficiently uniform in species, height and age to form a distinguishable unit.

Standards - Trees selected to remain standing after the rest of the stand has been felled.

Stocking - A relative term indicating (i) the proportion of area occupied by tree cover (e.g. 50%, 60%, etc.), and / or (ii) the actual basal area of trees / unit area expressed as a percent of the maximum.

Suppressed - Trees with crowns entirely below the general level of the canopy, receiving no direct light either from above or from the sides. Synonym: "overtopped".

Thinning - Cutting undesirable trees in an immature stand to hasten diameter growth and improve the average form of the trees that remain.

Thinning Guide - A chart used to determine the percent basal area removal and to predict stand growth over time.

Thinnings - Trees cut from a thinning operation.

Tree-length System - Felling and then transporting the limbed and topped stem in one piece for bucking at a landing or mill.

Wolf Tree - A vigorous tree, generally of poor form, occupying more growing space than its value warrants, thus harming or threatening the growth of quality trees. Note: Generally a dominant or co-dominant with broad spreading crown.

REFERENCES

Farm Woodland Practice. British Forestry Commission. Handbook 3.

Identification of Nova Scotia Woody Plants in Winter. Bulletin No. 19. James F. Donly. Joint publication N. S. Dept. of Lands and Forests and Forestry Canada.

Maple Syrup Production. 1975. Canadian Forestry Service Fact Sheet.

Practical Forestry for the Agent and Surveyor. 1967. Cyril E. Hart. The Estates Gazette Limited, Wardour St., London.

Silvics of Forest Trees of the United States. 1965. U.S. Department of Agriculture Forest Service. Ag. Handbook 271.

Silvicultural Systems. 1989. John D. Matthews. Clarendon Press Oxford.

Sugarbush Management. 1970. Clarence F. Coons, Ontario Dept. of Lands and Forests.

Sugarbush Management. A Guide to Maintaining Tree Health. 1990. D.R. Houston, D.C. Allen and D. Lachance. Forestry Canada and U.S. Forest Service. Tech. Report NE. 129.

Summer Key to the Woody Plants of Nova Scotia. 1955. Bulletin No. 16. A. E. Roland and D. A. Benson. N.S. Dept. of Lands and Forests.

Terminology of Forest Science, Technology, Practice and Products. 1971. Edited by F. C. Ford Robertson. Society of American Foresters, Washington, D.C.

The Trees Around Us. 1980. A joint production of Government of Canada - Province of Nova Scotia.

Thinning Tolerant Hardwoods in Nova Scotia. 1984. J. C. Lees. Information Report M-X-152. Maritime Forest Research Centre. Canadian Forestry Service.

Trees of Nova Scotia. 1989. (Revised Edition.) Gary L. Saunders. N.S. Dept. of Lands and Forests.

Woodlot Management Home Study Course, Module 3: Stand Spacing. 1987. Canadian Forestry Service / N.S. Dept. of Lands and Forests.

FURTHER READING

Forestry Field Handbook. 1988. (Revised Edition.) N.S. Dept. of Lands and Forests.

The Farm Tractor in the Forest. 1982. National Board of Forestry, Sweden, English translation - Forest Extension Service, New Brunswick.

Shelterwood Harvesting Manual. 1989. N.S. Dept. of Lands and Forests.

Forest / Wildlife Guidelines and Standards for Nova Scotia. 1989. N.S. Dept. of Lands and Forests.

NATURAL RESOURCES OFFICES

Annapolis County
P. O. Box 130
Lawrencetown, N.S.
B0S 1M0

Antigonish County
Provincial Building
11 James St.
Antigonish, N.S.
B2G 1R6

Cape Breton County
Coxheath Depot
R.R. #6 Sydney, N.S.
B1P 6T2

Colchester County
626 College Road
Bible Hill, N.S.
B2N 2R2

P. O. Box 68
523 Prince St.
Truro, N.S.
B2N 5B8

Cumberland County
P. O. Box 130
Oxford, N.S.
B0M 1P0

P. O. Box 428
Parrsboro, N.S.
B0M 1S0

Digby County
Hillgrove Depot
P. O. Box 57
Barton, N.S.
B0W 1H0

Guysborough County
P. O. Box 50
Guysborough, N.S.
B0H 1N0

R.R. #2, Aspen, N.S.
B0H 1E0

Halifax County
Box 23
Site 2, R.R. #1
Waverly, N.S.
B0N 2S0

P. O. Box 118
Sheet Harbour, N.S.
B0J 3B0

Lewis Lake Depot
R.R. #3 Armdale, N.S.
B3L 4J3

P. O. Box 190
Musquodoboit Harbour, N.S.
B0J 2L0

P. O. Box 112
Middle Musquodoboit, N.S.
B0N 1X0

Hants County
P. O. Box 190
Windsor, N.S.
B0N 2T0

P. O. Box 130
Shubenacadie, N.S.
B0N 2H0

Inverness County
P. O. Box 130
Whycocomagh, N.S.
B0E 3M0

Kings County
Provincial Building
136 Exhibition St.
Kentville, N.S.
B4N 4E5

Lunenburg County
Provincial Building
99 High Street
Bridgewater, N.S.
B4V 1V8

Pictou County
P. O. Box 457
(MacLellan's Brook)
New Glasgow, N.S.
B2H 5E5

Queen County
P. O. Box 190
Milton, N.S.
B0T 1P0

Richmond County
Provincial Building
P. O. Box 363
St. Peter's, N.S.
B0E 3B0

Shelburne County
P. O. Box 369
Shelburne, N.S.
B0T 1W0

Victoria County
P. O. Box 610
Baddeck, N.S.
B0E 1B0

Yarmouth County
R.R. #1 Yarmouth, N.S.
B5A 4A5

Kemptville Depot
Carlton, N.S.
B0W 1Y0

FORESTRY CANADA OFFICES

Forestry Canada - Maritimes Region
P. O. Box 667
Truro, Nova Scotia
B2N 5E5

Forestry Canada - Maritimes Region
P. O. Box 4000
Fredericton, New Brunswick
E3B 5P7

Forestry Canada - Maritimes Region
P. O. Box 190
Charlottetown, Prince Edward Island
C1A 7K4

NOTES

ISBN 0-88871-212-X
©Crown Copyright Province of Nova Scotia
Department of Natural Resources
Extension Services Division
5M/ 12 / 91